

John Mauro, PhD, CHP  
Senior Vice President  
S. Cohen & Associates

Testimony  
Before the Committee on Resources  
United States House of Representatives

Hearing on The United States Nuclear Legacy in the Marshall Islands:  
Consideration of Issues Relating to the Changed Circumstances Petition  
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STATEMENT BY JOHN MAURO BEFORE THE COMMITTEE ON RESOURCES  
REGARDING THE REPUBLIC OF THE MARSHALL ISLANDS' PETITION FOR  
CHANGED CIRCUMSTANCES

This statement was prepared by Dr. John Mauro as an employee of S. Cohen & Associates (SC&A, Inc.) of McLean, Virginia. On October 16, 1998, SC&A was retained by the Enewetak/Ujelang Local Government Council ("the Council") of the Republic of the Marshall Islands to assist the Council with respect to radiological issues concerning the remediation, restoration, and resettlement of Enewetak Atoll. This was the beginning of a long and productive relationship with the people and the leadership of the Republic of the Marshall Islands, which continues to this day.

I am here today to help the Committee on Resources and the Committee on International Relations Subcommittee on Asia and the Pacific achieve a deeper understanding of the facts associated with several complex scientific/regulatory issues addressed in the Petition for Changed Circumstances filed by the Government of the Republic of the Marshall Islands with the President of the United States Senate and the Speaker of the United States House of Representatives on September 11, 2000 ("the Petition").

Along with Dr. Hans Behling, also with SC&A, I contributed to portions of the Petition dealing with certain scientific issues that represent a change in circumstances that must be carefully considered by the Committee. However, two reports have been prepared in support of these proceedings that take issue with many of the findings that Dr. Behling and I present in the Petition. These reports are entitled "Congressional Research Service Report for Congress," dated March 14, 2005, and a report prepared by the Administration entitled "Report Evaluating the Request of the Government of the Republic of the Marshall Islands presented to the Congress of the United States of America Regarding Changed Circumstances Arising from U.S. Nuclear Testing in the Marshall Islands pursuant to Article IX of the Nuclear Claims Settlement Approved by Congress in Public Law 99-239," dated November 2004. The purpose of my statement today is to demonstrate that many of the scientific findings and regulatory positions

articulated in those reports are incomplete and/or incorrect, which brings into question the major conclusion of the Administration's report that "the Marshall Islands' request does not qualify as changed circumstances...." In the discussion that follows, I will refer to these reports as the CRS Report and the Administration's Report.

The Petition identifies a number of changed circumstances. I will limit my statement to those changed circumstances dealing with what I will refer to as "incomplete estimates of dose" associated with the BRAVO test and "changes in radiation protection and cleanup standards." I hope to demonstrate that, without a doubt, at the time of the enactment of the Compact of Free Association between the United States and the Marshall Islands, there was only a limited understanding of the extent of the health impacts of weapons testing in the Marshall Islands, nor had anyone anticipated the magnitude of the changes in the radiation protection standards and cleanup criteria that would occur over the subsequent 15 years. These two facts have substantial cost implications that go to the very heart of the reasons why changed circumstances provisions were incorporated into Article IX of the Section 177 Settlement Agreement. The CRS Report and the Administration's Report either disagree with our position regarding these matters, avoid discussion of some of these issues, or attempt to diminish the importance of these issues. I hope to demonstrate where the CRS Report and the Administration's Report are deficient with regard to these matters and convince the Committee that there have been substantial changed circumstances due to incomplete estimates of dose and changes in radiation protection and cleanup criteria.

#### Incomplete Estimates of Dose

SC&A has prepared three reports on behalf of the People of the Marshall Islands that describe in detail the historical doses associated with weapons testing in the Marshall Islands (SC&A 2000a; SC&A 2002a; and SC&A 2002b). Using many of the same historical reports and records compiled and used by the Atomic Energy Commission (AEC) and the Department of Energy (DOE) and its contractors, along with a large number of reports that were only recently declassified at that time, we derived doses to the people of the Northern Atolls associated with the BRAVO test that are significantly higher than those derived by the government and its contractors. Specifically, we believe that the whole-body doses associated with the BRAVO test were about two times higher, that the thyroid doses were many times higher, and that the previous dose reconstructions neglected to consider the very large doses that were delivered to the lining of the gastrointestinal tract due to the ingestion of short-lived radionuclides immediately following the test.

With respect to whole-body dose, the following is a reproduction of Table 1 (page 24) of the

## Administration's Report:

Tble 1. Comparison of Whole-Body Dose (rad) from BRAVO fallout by various reports and investigators.

Location	Sondhaus and Bond (1955)	Breslin and Cassidy (1955)	JCAE (1957)	Peterson (1981)	Lessard (1985)	Behling et al. (2000)
Rongelap	175	180 R	170	110	190	410
Ailinginae	69	60 R	75	24	110	215

The estimates by Breslin and Cassidy are either in roentgen (R) or dose to air (r); estimates in whole body dose (rad) would be approximately 0.88 times the reported value.

In coming to its conclusions regarding who is right and who is wrong, the Administration's Report simply states that "the weight of expert opinion remains in favor of an average external dose about one half those estimated by Behling." The fact is that all of the authors, except Behling et al., made certain assumptions or neglected certain exposure pathways that either missed important doses or neglected to give the benefit of the doubt to the people of the Marshall Islands. Specifically, the other studies neglected the dose from the passing plume, neglected the whole-body dose from fallout that deposited directly on the persons' skin and clothing, did not consider the unique exposure geometry associated with fallout, and made assumptions regarding the time of arrival of the plume and the duration of fallout that did not give the benefit of the doubt to the people of the Marshall Islands. These oversights and errors are discussed in detail in the SC&A reports. However, the most egregious error made by the other authors is that they all neglected the hematological clinical data collected from Rongelap evacuees that showed that the whole-body doses were, more likely than not, about twice the values estimated by the government and its contractors. The authors of the CRS Report and the Administration's report do not even attempt to address these critical facts.

SC&A 2002a and 2002c reviewed the clinical and hematological data reported by the U.S. physicians who attended the exposed population groups of Rongelap, Ailinginae, and Utrik as the most informative data for dose estimates. The results of these reviews are critical of the dose reconstructions performed by the government, as the following paragraphs explain.

In instances when radiation dosimetry is unavailable, many investigators have used the clinical hematological dose-response as a biological dosimeter that may then be used as a prognostic tool. The medical team at Kwajalein stated their concurrence regarding the dosimetric value of clinical hematological data in the following statements (Cronkite et al. 1956):

*Since it is generally agreed that the degree of change in the formed elements of the blood is the most useful clinical index of the severity of radiation damage, peripheral blood changes were relied upon as a major aid in evaluating the degree of radiation injury in each exposed individual. In addition, changes in the mean blood counts of the exposed groups were followed closely to aid in evaluating the changing status and probable prognosis of the exposed groups...*

Clinical changes that develop in the blood following acute exposure are most evident in select cells that include lymphocytes, neutrophils, and platelets. Among persons exposed on Rongelap, 42, or approximately 50% of exposed individuals, had neutrophil counts below 2,000 at some time during the observation period, and 10% had counts below 1,000. In their report, Cronkite et al. (1956) concluded the following:

*Some indications of severity of exposure can be gleaned from a comparison of minimum individual counts in Japanese groups in which fatalities occurred. In general, a significant number of deaths was encountered only in individuals whose neutrophile count fell below 1000 . . .*

*. . . By this criteria, then, the effective dose received by the Rongelap people approached the lethal range.\**

On the basis of these conclusions, Cronkite et al. (1956) also had doubts about the accuracy of the assigned dose, as given in the following statements:

*The high initial incidence of nausea, vomiting and diarrhea in the high-exposure Marshallese group, and the profound neutrophile and platelet count depression indicated a greater effect that might have been expected from 175 R . . . As indicated in Chapter IV . . . and from the degree of leukocyte depression it is possible to estimate the dose at which a small incidence of mortality would have resulted without treatment. [Emphasis added.]*

In summary, SC&A's revised estimated dose of approximately 400 R to the maximally exposed Group 1 Rongelapese is, therefore, fully consistent with the opinions expressed by the medical doctors who treated the BRAVO-exposed population groups. In addition to the above-stated benefit of medical intervention, perhaps a more compelling reason that explains the absence of mortality is the fact that the exposure experienced from fallout was not instantaneous but corresponded to a protracted exposure period of more than two days. Animal studies have shown that under similar protracted exposure conditions, the mid-lethal dose is increased to between 550 to 650 R.

With respect to the doses to the thyroid gland, the disagreement between the SC&A reports and the reports prepared by the government and its contractors is equally profound. The CRS Report and Administration's Report address the follow-up clinical investigations of the incidence of thyroid cancer in the Marshall Islands, but are silent on the validity of SC&A's position regarding the thyroid doses experienced by the people of the northern atolls following the BRAVO test. Using the same data compiled by government contractors, SC&A has determined that the various government reports significantly underestimated the doses to the thyroid gland. The underestimates are due to (1) neglecting extensive evidence that, due to

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\* Note: When the radiation dose is instantaneous (as was the case for Japanese A-bomb victims) or is delivered in a very short time period, a mid-lethal dose of about 450 R is generally assumed.

relatively low amounts of stable iodine in their diets, the uptake of radioiodine by the people of the Marshall Islands is likely to have been several times higher than assumed by the government, (2) neglecting evidence that the size of the thyroid gland of the people of the Marshall Islands is smaller than assumed by the government, (3) failure to properly account for the daily urinary volume excretion fractions in deriving radioiodine intakes, (4) failure to account for thyroid dose due to skin contamination, (5) underestimate of the whole-body dose, which contributes to the thyroid dose, and (6) failure to give the benefit of the doubt to the Rongelap evacuees regarding questions pertaining to the time urine samples were collected and the time radioisotopic analysis of urine was performed. As is the case for whole-body exposures, the final proof that the thyroid gland doses were significantly underestimated by the government comes from clinical data that demonstrate that, in order for the people of Rongelap to have experienced the amount of thyroid damage observed, the radiation doses to the thyroid gland had to have been much higher than those estimated by the government. In fact, the BEIR III and BIER V Committees (NAS 1980 and 1990), the National Academy of Sciences (DCPA 1973) and others (Larsen et al. 1978, Conrad and Bustad at 1969 Conference) expressed disbelief that such severe thyroid disorders could have resulted from the relatively low thyroid doses estimated by the government. It was not until the investigations reported in SC&A 2000a and 2002a that the reasons behind these apparent incongruities between the government's reconstructed thyroid doses and the observed clinical effects on the thyroid glands of the people of the northern atolls were explained.

There were many other oversights in the government's reports related to internal doses from the ingestion of radionuclides that are described in SC&A 2002 a and b. However, by far, the greatest of these oversights was neglecting the dose to the intestinal mucosa from short-lived, highly insoluble radionuclides that were ingested by the people of Rongelap immediately following the arrival of the BRAVO plume and prior to their evacuation. We estimated that the doses to the intestinal mucosa were hundreds of rem. These dose estimates were recently confirmed in a paper by Moeller and Sun 2002. This issue is not mentioned in the CRS Report or the Administration's Report.

What does all this mean with regard to changed circumstances? In my opinion, it means that many errors and oversights were made by the government in assessing the health impacts of weapons testing at the time of the Section 177 Settlement Agreement. As such, explicit consideration must be given to this new information in achieving an equitable resolution regarding this aspect of the Petition.

#### Changes in Radiation Protection and Cleanup Standards

SC&A has prepared a number of reports addressing the cleanup needs and associated costs for several of the northern atolls, including Enewetak (SC&A 1999a), Bikini (SC&A 1999b), Rongelap (SC&A 2000b), and Utrik (SC&A 2002c). These reports were litigated before the

Nuclear Claims Tribunal and some have been ruled upon by the Tribunal.\*\*

SC&A's reports included the following:

1. An evaluation of the potential radiation doses and radiological health risks to the current populations on the atolls and the populations that may resettle many of the atolls in the future due to residual contamination in the soil, food, and water on the atolls. The results of the evaluations were compared to the radiation protection criteria used in the U.S. for cleanup of sites contaminated with radioactive material, and adopted by the Nuclear Claims Tribunal for use by the Republic of the Marshall Islands; and
2. An evaluation of the costs associated with the remediation of the islands to the U.S. cleanup criteria using a broad range of alternative strategies. The evaluations included recommended remediation strategies for each atoll and their associated costs.

The results of these recommendations represent a changed circumstance because the cleanup criteria and cleanup costs determined by SC&A and ruled upon by the Tribunal were not adequately understood at the time of the Section 177 Settlement Agreement. Hence, by definition, the rulings of the Nuclear Claims Tribunal can be considered a changed circumstance.

The CRS Report and the Administration's Report take exception to SC&A's findings and recommendations, and the rulings of the Nuclear Claims Tribunal, for reasons that I believe are not related to scientific issues, but are more appropriately categorized as regulatory issues. I believe the authors of the CRS Report and the Administration's Report would agree with the radiological data we used in our analyses, because the data were compiled by government contractors and have undergone extensive quality assurance and peer review. I believe the authors of the CRS Report and the Administration's Report would also agree with the methods employed in our reports for performing cost analyses of alternative cleanup strategies, because the unit costs that we used were based on data and reports prepared by the Bikini Atoll Rehabilitation Committee (BARC), which was established at the request of Congress (House Report 99-450) to report independently on the feasibility and cost of rehabilitating Bikini Atoll. I also believe that, if the authors of the CRS Report and the Administration's Report agreed that the regulations and guidance promulgated by the U.S. Environmental Protection Agency are applicable to cleanup decision-making in the Marshall Islands, they would agree with the results and conclusions of our work and the findings of the Tribunal. However, throughout the CRS Report and the Administration's Report, the authors take exception to the use of EPA criteria and

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\*\*It is noteworthy that none of these reports are cited in either the CRS Report or the Administration's Report. It is also important to note that our work would not have been possible without the excellent work and incredible amount of data compiled by Lawrence Livermore National Laboratory (LLNL) under the direction of Dr. William Robison, and by the Nationwide Radiological Study (NWRS), under the direction of Dr. Steven Simon. We have reviewed their work in detail, performed independent walk-over surveys of many of the islands on several atolls, collected and analyzed samples of soil and food on Utrik and Ailuk, and have come up with virtually identical results.

guidance as the basis for cleanup decision-making in the Marshall Islands. Therefore, this is a matter that is more appropriately addressed by the Nuclear Claims Tribunal. However, in my opinion, if the Marshall Islands were a State within the U.S., there is little doubt that cleanup of the northern atolls would be required to meet the same criteria that are used to clean up sites contaminated with radioactive material in the U.S.

Notwithstanding one's opinion regarding the appropriate criteria and methodologies that should be employed in determining the types and costs of cleanup of the current levels of residual radioactivity in the Marshall Islands, there is absolutely no doubt that the regulations governing radiation protection of the public and the criteria for cleanup of sites contaminated with radioactive material in the United States have changed dramatically since the Section 177 Settlement Agreement was established. Rather than repeat these changes here, I would refer the Committee to Appendix D of the Petition.

In conclusion, it is noteworthy that the amount of radioactive material in soil, food, and water of the Marshall Islands has not increased since the establishment of the Section 177 Settlement Agreement. In fact, the amount of radioactive material in the environment has declined somewhat due to primarily radioactive decay. However, since the establishment of the Section 177 Settlement Agreement, we have gained a more complete understanding of the radiation exposures and potential health impacts that were experienced by the people of the Marshall Islands due to weapons testing. These exposures and their potential health consequences are much larger than previously believed. In addition, subsequent to the establishment of the Section 177 Settlement Agreement, the radiation protection standards for members of the public and the cleanup criteria for sites contaminated with radioactive material changed dramatically. The standards are a lot more protective now than they were at the time of the Agreement. I believe that these represent changed circumstances that could have a direct bearing on the cost of medical care and certainly greatly increase the cost of remediation.

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